Lymphatics.—An attempt was made to demonstrate these by means of a method suggested to me by Dr. E. O. Shakespeare. The abdomen of an etherized animal was opened and a stick of diluted nitrate of silver rubbed over the surface of the liver. In a half an hour the animal was killed and sections made with the freezing microtome. In the two experiments made in this manner, the peritoneal surface was coloured with the nitrate of silver, but there were no lines going inward to indicate the course of the deep lymphatics.

ARTICLE XIV.

SANITARY DRAINAGE. By M. CAREY LEA, Esq., of Philadelphia.

IT is only of late years that attention has begun to be intelligently directed to the dangers which we have introduced into our houses together with the "modern conveniences." The investigation of the subject has revealed both ignorance and recklessness—ignorance of the laws which govern the movements of mixed liquids and gases in more or less confined tubes, and recklessness in introducing fixtures connected with sewers and imperfectly protected from sewer gas into confined spaces adjoining sleeping rooms, and connected with them. The results have been such as to make it evident that there exists a pressing need for a wide diffusion of knowledge on the subject of drainage, especially amongst medical men, in order that they may insist on a radical change in certain of the methods now in use. For want of this reform, it is no exaggeration to say that not a house in a hundred in any of our large cities is properly protected from sewer gas.

Soil Pipes and Traps.—To correctly understand the workings of our most common arrangements for drainage, it is desirable to obtain an insight into the nature of the movements of currents of water and air mixed in tubes.

Over the pipe of a water faucet let us attach a few feet of rubber tube, and insert in the other end of the rubber tube a glass tube as thick as a quill, and two or three inches long. Let another glass tube of half an inch internal diameter and three or four feet long be held vertically in a glass beaker. If now we insert the small glass tube into the upper end of the vertical tube, and turn on water, we shall find that the water in descending carries with it a great quantity of air, which becomes entangled in the descending current, and rises tumultuously in bubbles in the beaker.[1]

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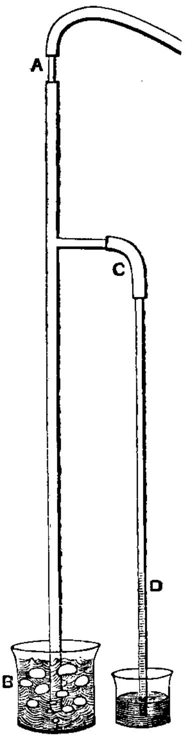
[1] The principle here involved is used on a great scale in Catalonia for providing an air blast for furnaces. Mountain streams are conducted over steep cliffs and into large pipes, too large to be filled by the stream, which in descending produces a powerful and steady blast of air.

If we now insert a small horizontal tube into the side of the larger, a few inches from the top, we shall find that a powerful *suction* is exerted through the horizontal tube, which may be rendered evident by applying a taper, or, still better, by attaching a glass tube by a short tube of rubber, and plunging the lower end of the tube in water. The extent to which the water rises will mark the amount of suction exerted. For many years past I have used both these forms of action in my laboratory, the one for driving blowpipes, the other for aspirating. For both purposes the results are most excellent.

Fig. 1.



In the upper end, *A*, of a tin tube is loosely inserted a glass tube of much smaller diameter, connected by a rubber pipe with a water faucet. On admitting a stream of water through the small tube at *A*, great quantities of air are carried down into the beaker *B*, together with the water.

If a small tube *C* is inserted into the side of the vertical tube, a powerful suction is found to be exerted in it, which may be measured by attaching a rubber connection to a glass tube plunged in water. The height, *D*, to which the water rises measures the amount of suction exerted.

The principles involved in the above experiments will explain the most complicated actions which take place in soil pipes and water-closet traps. The action of the discharge water in a soil pipe is precisely similar to what takes place in the pipe *A B*, and the aspiration or suction through *C* is exactly what occurs in traps attached laterally to the soil pipe.

The most common form of arrangement in houses built within the last generation is to have a bath and water-closet on the second story, and the same on the third, immediately over those on the second story, and using the same soil pipe. Older houses have been mostly altered to correspond more or less with the above mentioned arrangement. Wash-basins with water-faucets are very variously distributed, but connect by longer or shorter waste pipes with the soil pipes at or about the same places where the bath and water-closet discharge. I shall, therefore, as a general form, consider the case where a bath, closet, and basin are placed in a second story room, with a similar arrangement in the story above, all served by one soil pipe, terminating just above the third story attachments, and connected to it through separate traps. If the bath is connected to the water-closet trap, as is most commonly done, I shall suppose the precaution taken (which, although essential, is generally neglected) of having a trap between the bath and the water-closet trap.

Experience has shown that in such an arrangement it happens that when one of the larger fixtures is used, that is, either bath or either water-closet, it follows that one or more traps are sucked out, and free access allowed for sewer gas to enter the house, and this, not as an exception, but rather as the rule.

On examination we perceive that this evil comes in a variety of different ways, to wit:—

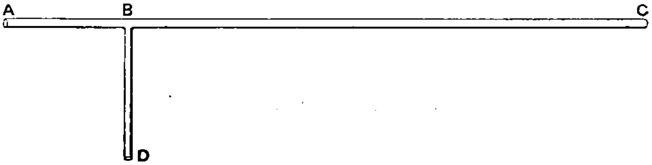
1. The use of a lower fixture may suck out an upper trap.
2. The use of an upper fixture may suck out a lower trap.
3. The use of any fixture may suck out another trap on same level; and lastly,
4. The using of any fixture may result in *its own* trap being sucked out.

(These distinctions are important because the remedies are different.)

The first capital improvement introduced into drainage was the carrying of the soil pipe of full size to and above the roof. This is indeed the foundation stone of all good plumbing. By itself, and without other aid, it cures *two* of the above cases, the first and third, and it also renders possible the curing of the other two, with the aid of other arrangements.

Case 1. The simple carrying of the soil pipe to the roof, without diminution of size, may be said to cure Case No. 1, at least where the soil pipe has been given a full diameter in proportion to its length. The importance of a full size has, I think, not been sufficiently insisted on. The principle on which it depends, will be understood by the following experiment:—

Fig. 2.



A tube, *A B C*, has one of a little smaller size, *B D*, inserted at right angles. Over the end *A* is to be passed a rubber tube. In a flat-bottomed vessel some strongly coloured liquid is to be poured to the depth of an eighth of an inch. Into this the extremity of the tube *B D* is plunged. If now, the end *C* being freely open, we apply a gentle and steady suction at *A*, by means of the rubber tube, the air in *B D* is not disturbed, nor does the liquid rise in it. But if a sudden suction is applied, the liquid rises in *B D* for a moment, and, by its colour, leaves a mark on the tube to show the height to which it rose. In order to get some rough numerical data, it was found that when *B C* was $\frac{1}{5}$ inch diameter and 34 inches long, a tolerable suction raised the liquid in *B D* 1 inch, and a strong suction $1\frac{1}{2}$ inches. In this case the length of the tube *B C* was 170 diameters, and might be said to roughly correspond with a soil pipe having a diameter of 4 inches and length of 57 feet. Comparisons of this sort are however, to a large extent, illusory, and the experiment must be taken simply as illustrating the principle and indicating the danger.

The action in the soil pipe is precisely of the same nature. If the water from the emptying of a fixture descended slowly and regularly, no influence whatever would be exerted on the lateral trap in the story above, because of the slight friction of gases in moving through tubes.[1] But the sudden descent of a body of water by the emptying of a water-closet or bath, creates a suction similar to that shown in the experiment just described; and although the suction is but mometary, that moment is sufficient to empty a trap, which has rarely more than 2 or 3 inches seal. To prevent the upper trap from being emptied, we must make the entrance of air through the top of the soil pipe as easy as possible. Any contraction, therefore, of the pipe is most strongly to be objected to. The placing of a strainer or grating over the end is to be entirely condemned. There must be nothing to interfere in the smallest degree with the freest possible entrance of air at the top, to relieve the suction and save the traps. With a closed soil pipe, such as even at this time is very generally used, *this emptying takes place with the utmost facility*, and may be said to be the rule rather than the exception.

Case 2. Even with an open soil pipe, the use of any upper fixture, especially one using as much water as a water-closet or bath, may and does suck out any trap on a lower level.

The manner in which this takes place is exemplified at Fig. 1. The lateral suction caused by a descending current of water in a pipe easily empties a trap.

The remedy for this lies in *ventilating the trap*. (This expression, which has passed into general use, tends to create a false impression; the object is not to purify the air in the trap, but, by providing for the free admission of air, to prevent emptying by suction.)

A pipe of sufficient diameter to admit of air freely (see Figs. 3 and 4) is attached at the upper side of the trap nearest the soil pipe. This pipe is carried upward parallel with soil pipe, and connected with it at a point *fairly above every other connection whatever that is made with the soil pipe.* This last point cannot be too strongly insisted upon. To attempt to ventilate a second story trap by a pipe that connects with the soil pipe *under* the third story attachments is absolutely useless. One ventilating pipe, however,[2] will answer for a whole series of water-closets

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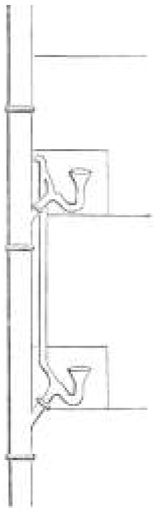
[1] The experience of gas manufacturing shows that a single inch difference of water-level will drive gas thousands of feet through gas mains.

[2] In the most modern system of English plumbing the ventilating pipe leaves the soil pipe at its trap into the drain; two or three feet beyond it is carried *into the soil pipe*, and rises through the centre of the latter to the roof, where it is carried out

Fig. 3.



or other fixtures. It should not be of too small diameter, though it is quite unnecessary in my opinion that, as sometimes alleged by good authorities, the ventilating pipe should have the same diameter as the trap which it ventilates. The friction of air in pipes, as above pointed out, is very small, and the admission free. Something will of course depend upon the number of stories on which fixtures are placed, and the number of water-closets and baths. For the common arrangement of a bath and closet on each of two stories, a ventilating pipe of two inches internal diameter should, I think, be held sufficient, if not narrowed at its connections by bad plumbing. Additional size, however, can never be a disadvantage.

Case 3. When the common closed soil pipe is employed, the use of any fixture may cause suction enough in the soil pipe to empty the trap of another on the same level. But the open soil pipe cures this as well as Case 1; because the suction in the soil pipe takes place *below* the point at which the water enters, and therefore other fixtures which enter the soil pipe on same level are relieved by the air entering the open end of the soil pipe. (But if two fixtures on the same floor tap the soil pipe, the one below the other, the use of the upper fixture may suck out the lower. The ventilating pipe avoids this danger.)

Case 4. The case of a fixture sucking out its own trap might, at first sight, seem to depend on the same conditions as Case 3; but this is far from being so. A fixture may suck or siphon itself out even with an open soil pipe.

Fig. 4 represents an ordinary S-trap terminating in a vertical pipe. If water trickles only into the upper opening *A*, it will escape by the lower, and leave the trap full. But if the current of water is enough to fill the tube, then, when it is stopped, the water in the lower branch will siphon the trap out. Even if the water does not fill the tube sufficiently to siphon it out, it may by entangling air, in the manner already described, produce a suction sufficient to empty the trap.[1] The remedy lies as before in Case

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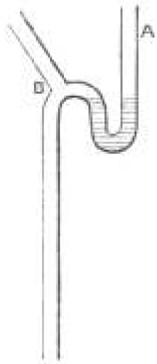
again. The ventilating pipes of the several traps pass through the soil pipe into the interior ventilating pipe. Those who may wish to examine further into this method will find it illustrated with excellent diagrams in the "Plumber and Sanitary Houses," by Hellyer, London, 1877. But the soil pipe thus partly filled up would seem to be easily choked or stopped up by substances improperly thrown into water closets by servants.

[1] It is believed that the emptying of traps by suction, created by the joint action of air and water in the pipes, on the principle of the Catalonian Blast, is here explained for the first time. This emptying has always hitherto been explained on the principle of the siphon. No doubt siphoning, correctly so called, may occasionally take place, but for this the quantity of water descending must, in the vast majority of cases, be altogether insufficient, especially in the case of soil pipes, the most ordinary one. To

Fig. 4.



2, in ventilating the trap by introducing a tube at *B*, through which air can enter, as shown in Figs. 3 and 4.

We see, therefore, that these two capital improvements, the *carrying of the soil pipe above the roof* and the *ventilation of traps*, are sufficient to remove all danger of the introduction of sewer gas by the removal of the water seal of traps.

Before leaving this part of the subject one remark remains to be made. In the case of the small S-traps used for the waste pipes of wash basins, the orifice at *B*, figure 4, of the ventilating pipe is liable to be sometimes filled up by grease from soap. *The trap can then be siphoned out*, and sewer-gas be admitted (provided the sewer traps are not arranged as hereafter to be described). For this reason, instead of ventilating the basin traps, I prefer to use Bowers's traps. It is proper to say, however, that good authorities differ on this point. All bottle traps are liable to form collections of grease in the glass reservoir, finally stopping their action. But this trouble makes itself quickly evident; the basin will not empty. The remedy does not even need a plumber to apply it; anyone can unscrew the glass reservoir, empty, and replace it. But if the orifice *B* of the S-trap is stopped, it may not attract attention. Foul smells may be perceived, but the cause is not at once evident.

Sewer Connections.—Until very lately it has been universally considered that when a trap was interposed at the connection of the drain with the street sewer, all had been done that the most exacting could require. Experience has taught the contrary.

A sewer is an opening of immense length as compared with its breadth. The breadth is confined to a few feet, the length may extend for miles. When heavy rains take place a powerful current passes through, and the result may be either an expansive force or one of suction. The water in the river or bay that serves as outlet may or may not cover the mouth of the sewer, depending in some cases on tides, or, in the case of inland rivers, on the high or low water at different periods of the year. When the mouth is covered by water, a material obstacle is placed against the exit of the drainage.[1] A powerful expansive force results in the sewer, which must often be far more than sufficient to force the few inches of water seal in the traps along its course.

When the mouth of the sewer is uncovered, and perfectly free passage

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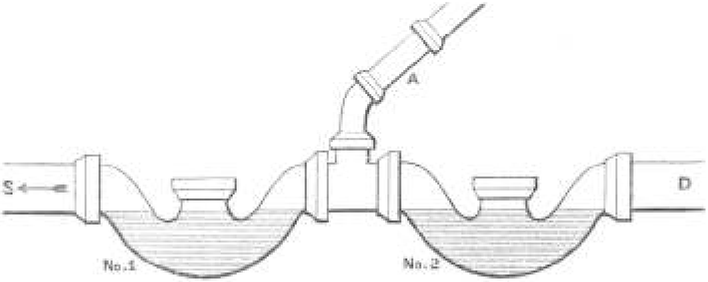
produce a siphoning action the longer leg must be full of water. The least consideration will show that this can never take place in an ordinary soil pipe by the emptying of either a water-closet or a bath.

[1] In Philadelphia instances have come to my knowledge where a heavy rain has completely filled a sewer to the top, for a distance of half a mile or over, back from the Delaware.

for its contents afforded, the action is reversed, and a force of suction ensues. This force seems to be generated somewhat in the same manner as in the case of vertical tubes already described. It is sufficient that impediments, sharp turns and the like, should at any point dash the water about so as momentarily to fill the whole section of the sewer. This suction empties the traps along the line of the sewer, and leaves free passage for sewer-gas when the sewer returns to its normal condition by the cessation of the rain.[1] Expansion and contraction may also arise from simple changes of temperature, and in the absence of rain.

Both these evils, of suction and of forcing, are cured by a single ingenious arrangement; that of placing two traps instead of one at the sewer attachment, with a ventilating pipe between.

Fig. 5.



In this figure, *S* indicates the direction of the street sewer, *D* shows the end of the house drain. The ventilating pipe, *A*, is conducted to the pavement, or, better, into a kitchen flue, in the manner to be presently described.

Between the drain and the sewer are interposed two traps,[2] Nos. 1 and

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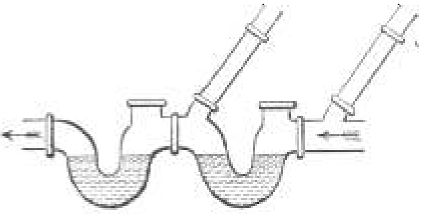
[1] The same cause, the rain, which may tend to make a sewer suck out a trap, naturally tends also to refill the trap by the surface drainage of the house. So that, in a heavy rain, it may happen that a trap is many times sucked out and refilled. The question arises, Which action will continue longest; will the trap finally be left full or empty? The answer, I think, is, *empty*, for the sewer drains a much larger area than that of any one house, and the rush of water must continue in it after it has ceased in the house drain.

[2] The traps which I have shown in the above figure are of the shape usually employed in Philadelphia, and have the cleaning hole in the centre. Fig. 6 shows another form, narrower and deeper, with the cleaning hole at the top of one of the branches. It is unimportant which shape is used, provided the trap is well made. Some have the fatal defect that the depression is not sufficient to cut off the air passage, and consequently affords no protection whatever.

Fig. 6.



2. If there is a suction in the sewer, and trap No. 1 is sucked out, air rushes in through the ventilating pipe and relieves the suction. Trap No. 2 remains unaffected. If there is an expansive force in the sewer, and gas is blown through trap No. 1, it passes off through the ventilating pipe. For the reasons already given, it *cannot* force the second trap when the ventilating pipe is open. So that, under any circumstances of suction or pressure, trap No. 2 remains in working order and protects everything behind it.

It might be asked, why not omit trap No. 1 altogether, inasmuch as it is the ventilating pipe, and not trap No. 1 that secures trap No. 2. It is perfectly true that trap No. 1 does not even aid in preserving trap No. 2; that is not its function. But it is not desirable that the ventilating pipe should at all times allow free escape for gases from the sewer. The function of trap No. 1 is to prevent this, and admit of the escape of gases through the ventilating pipe only under extraordinary circumstances.

As to the disposition to be made of the ventilating pipe, there exists a difference of opinion. Some advise to carry it to the pavement, others to bring it into the kitchen flue. In my opinion neither of these plans is desirable. The proper course is to carry it into the kitchen flue, and to continue the pipe up to and above the top of the chimney.

With these precautions the drainage of a house may be considered safe, with one exception, that the house drains themselves should be ventilated.

Ventilation of House Drains. — The arrangements already described for ventilating inside traps do not ventilate the drains themselves; nor does the ventilating pipe just above described. Their functions are limited to preventing the sucking or forcing of the traps to which they are attached. By the ventilation of drains is intended something quite different, viz., the establishment of a current of air through the drain pipes to prevent the collection of foul gases in them.

The necessity for such ventilation varies very much in different cases, and in this respect differs wholly from the foregoing precautions, which must be considered as indispensable in any case. A small house, the drainage of which is carried by a short pipe having considerable pitch directly into a sewer within a few feet of the house, may possibly not need to have its drains ventilated otherwise than as previously described. As the size of the house increases, and with its size the complexity of its drainage, the need of ventilation rapidly augments. Of late years it has been customary to build rows of houses with a drain pipe running in the rear, and making one connection only with the sewer for the whole row. At the present day it is probable that more houses are built in this way than with separate sewer connections. In such rows the main drain forms almost a small sewer in itself, and it and the whole system of pipes connecting with it should be ventilated. To a certain extent this result is unintentionally effected by the rain-water pipes, which tend to act as flues.

But the upper ends of these pipes are almost always in close proximity to windows; those of back buildings to the higher story of front buildings, those of bay windows to the windows above, and in the very common case of mansard roofs the openings of the main-building rain-water pipes are close to the mansard windows. Consequently foul odours enter the windows in summer. To cure this evil, traps are probably put to the rain-water pipes, and thus the drain is corked up and ventilation stopped.

In the few cases where any express ventilation of drain-pipes has been attempted, it has been done by cutting openings into kitchen flues, and establishing a connection between the drains and the flue. This has always seemed to me a very dangerous proceeding. It is true that when the fire is allowed to go out in summer nights, it is *probable* that heat enough will remain till morning in the stack to maintain an upward current, but this is a poor dependence. When, however, the house is shut up for a period, this heat in the stack quickly disappears, and then the kitchen flue is precisely like any other opening. The house being closed up, all expansions and contractions must chiefly regulate themselves through the flues. Every change of temperature, and every barometric change, starts a current up or down the flues, and as often down as up. When the current is downward, the drain is freely ventilated into the house. Let anyone consider then, what condition a house is likely to present in the autumn which throughout an entire summer has had, during one-half of each day on an average, sewer gas freely poured into it.

How then shall the advantage of artificial ventilation be attained without this danger? In place of carrying the connection simply *to* the kitchen flue, let it be carried by a stout iron pipe *to and above the top.*

This admirable plan, though mentioned in some of our latest text-books, has so far been but little adopted. The architect or the owner is too apt to think that when a pipe has been carried to the kitchen flue, all has been done that is required, and the device in this form has long been a favourite one; the danger which arises from a temporary closing of the house is almost invariably overlooked or disregarded.

Carrying the pipe to the top of the chimney has every advantage on its side. Not only is the danger of escape into the house completely got rid of, but it is evident that the draft in the ventilating pipe must be greatly increased. For the pipe over the whole length is heated, and the lower part very considerably. A column of well-heated air, thirty or forty feet in length, must always give rise to a far more powerful draught than the comparatively slight force of suction produced by the draught of a chimney upon a lateral opening. Yet, as already said, this latter plan, although capable of little good and much mischief, is largely used, and the better method almost unknown. Probably this is in part owing to the very recent introduction of the better method, and in part to persons being unaware that the latter can be introduced without serious difficulty into houses already built. As to this, the writer can speak from experience, having caused it to be introduced into chimneys in a row of houses on Broad Street, above Montgomery Avenue, in the city of Philadelphia, of which he directed the construction. After applying all the improved methods detailed in the course of this paper, it was concluded that the system would not be complete without a special plan for artificial ventilation of the whole system of drain pipes, soil pipes, and rain conductors. At the time when this decision was reached, the kitchen chimneys were already built. It was not, therefore, practicable to raise the iron pipe in sections along with the chimney; the much more serious problem presented itself of introducing a pipe into chimneys already built, and between thirty and forty feet in height. This was, however, found to be practicable. The plan adopted was to put a derrick on the roof, lower the pipe in sections, screwing each into the previous. The lowest section was bent horizontally at bottom. A hole was cut into the kitchen flue just over the range, the hand passed in, and when the lowered pipe came opposite it was seized and drawn through, and secured to the lower exterior portion. To render the return of any gas absolutely impossible, the following arrangement was made. On the top of the chimney a flat cap-stone was laid, with openings underneath for escape of smoke. The ventilation pipe was carried through a hole cut in the cap-stone, and continued six inches or more higher. A connection of this kind at both ends of the row and at several intermediate points must establish in each case a powerful upward current, and produce a slight exhaustion in the main drain, supplied by liberal currents of fresh air entering through rain water pipes and down soil pipes (with open ends above the roof), thus keeping the air in the drains constantly fresh, and dispersing the gases where they can do no harm.

These details have been thought worth mentioning here; partly, because they show the practicability of introducing a really effective drain ventilation into a house already built, and partly because they indicate an improved method of arrangement; it is believed that the plan of putting the ventilating pipe through the cap-stone, whilst the smoke flue ends below it, has not previously been described.

I have been asked, before concluding this paper, to discuss more particularly the result likely to follow an attempt to improve the sanitary condition of a house by connecting the drain with the kitchen flue, in the manner commonly practised and already condemned. The occupant of a house becomes solicitous about his drainage, and asks a plumber what can be done to render it safe, in a simple way. The plumber advises to attach a ventilating pipe to the lower part of the drain, and carry it to the kitchen flue, and recommends the plan as being cheap and effective.

As this mode of improving drainage has received a large acceptance, it seems worth while to study its results; and the first point that attracts our attention is that, as respects the siphoning out of traps on the stories above, the great difficulty of modern plumbing, *it cannot exercise the slightest influence.*

To understand what influence it does exert, it is necessary to know whether or not an effective trap exists on the main drain. If there is no such trap, then the ventilation pipe simply ventilates the *street sewer* into the house. As long as there exists an upward draught in the kitchen flue, no evil result may be felt, but as soon as this ceases to exist, the house must be filled with sewer-gas, to a horrible extent, from the absolutely free communication afforded.

If, on the other hand, there exists a trap on the main drain in working order, the result will be different according as the plumber attaches his ventilating pipe on the sewer side or the house side of this trap.

If *on the sewer side*, the ventilating pipe will have the useful effect of preventing the trap from being either forced or sucked out by expansions or contractions in the street sewer. But this useful effect will be much more than counterbalanced by the house being placed in free connection with the street sewer, except as protected by the draught in the kitchen flue.

If the ventilating pipe is inserted *on the house side* of the trap, then the house will be defended against the sewer by both the draught in the kitchen flue and the trap. But in this arrangement the trap itself is no longer defended by the ventilating pipe, and is liable to be sucked or forced by the street sewer. If the trap is sucked out, then, as long as it remains in that condition, there is a free communication between the house and the street sewer, precisely as if there were no trap.

It is therefore to be concluded that this mode of ventilation is at best but a poor expedient. The most important object of all, the protection of the upper traps, it does not in the least effect. What of good it accomplishes in drawing off foul air from the pipes, is largely counterbalanced by the dangers it brings in case of closing up the house. And when sewer poison is thus introduced, it is quite impossible to say how long traces of it may remain in spite of the most careful ventilation. The sense of smell can give no information as to this point. It should be understood that when this arrangement is used, it is of vital necessity to provide a good S trap between the point at which the flue-pipe is connected with the drain and the street sewer. But the whole arrangement, even at its best, cannot be approved or sanctioned, and should be entirely abandoned. It is even probable, that whoever first introduced this expedient, had no clear idea of what he expected to effect by it, but had merely a vague notion of conducting foul vapours into the kitchen chimney; and those who now recommend it, do so simply because it has become a recognized form of proceeding which it is easier to adopt than to examine and study out. Such expedients might be excusable if the right methods were not simple and practicable. These have been here already fully described, but may be briefly recapitulated: 1. Let the soil pipe be carried of full size and wholly unobstructed to and above the roof; *nothing* can take the place of this. 2. Let every water-closet trap be ventilated; every bath trap also, if it separately connects with the soil pipe; and let every wash-basin have a good bottle trap. 3. Let there be two good S traps, with ventilation pipe interposed (see Fig. 4) between the house and the street sewer. In this, and in no other way, can a house be made safe.

If space permitted, I should have wished to say something on the subject of the *selection of water-closets.* I must, however, limit myself to recommending the rejection of the old-fashioned "pan-closets," and the use of a good form of valve-closet in which there is no tilting pan. Forms of water-closet advertised as "requiring no trap," should either be avoided, or have a trap attached.

Finally, it may be said that in view of the vast amount of preventable mortality that arises from defective drainage, it is greatly to be desired that public opinion should be educated to the point of requiring from architects and builders a stricter compliance with the laws of sanitary engineering, and it is probable that much good might result from the passage of city ordinances compelling attention to some of the most vital points. Thus an ordinance requiring that every soil pipe should be continued of full size to and above the roof, and not be allowed to serve as a rain conductor; and that no drain should be allowed to make connection with the sewer without at least one well constructed trap, or better with two, as here described, would be of vast utility in improving the health of the poorer classes. Those who can afford better habitations, and who can think and judge for themselves, should insist on all the precautions briefly explained in this paper, as the indispensable conditions for preserving health.

ARTICLE XV.

GUNSHOT WOUND THROUGH BOTH HEMISPHERES OF THE BRAIN; RETENTION OF BULLET IN THE CRANIAL CAVITY; CONVULSIONS, RECOVERY, WITH PERSISTENCE OF ALL THE CEREBRAL FUNCTIONS.

By P. F. HARVEY, M.D., Captain and Assistant Surgeon, U.S.A.

ON the night of November 18, 1878, at half-past nine o'clock, a letter was handed me by a courier from Poplar River, M. T., announcing the accidental wounding of Dr. G. A. S., Agency Physician of the Indian Agency situated at that place, sixty-five miles distant, and requesting my attendance as soon as possible. The letter was from Dr. W. Bird, the agent in charge, and stated, *inter alia,* that Dr. S. had received a wound in the